

23rd International Conference on Subterranean Biology

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The 23rd biennial International Conference on Subterranean Biology was held on the campus of the University of Arkansas in Fayetteville from June 13 to June 17, 2016. As is usual for these meetings, there was a strong international representation, with 125 participants from 17 countries, including for the first time, a strong group from the People's Republic of China. It was the first meeting held in the United States and only the third meeting in the Americas (previous meetings were in Brazil and Mexico). It was also the first meeting covered by a reporter from *Science* (Pennisi 2016). It was also the most digital of meetings – the abstracts were available in a digital version and the conference itself was documented in social media, including Facebook and Shutterfly. The talks were organized into two broad themes – the ecological theater and the evolutionary play – taken from the book with the same name, written by the famous ecologist, G. Evelyn Hutchinson.

The results of the evolutionary play are of course species, and the description of new species has long been a strength in the research reported at these meetings, and given the high endemism of the subterranean fauna, it has long been the primary activity of speleobiologists. This meeting was no exception, with reports of new species descriptions and diversity patterns from around the world, including Australia (Cooper, Harms, Perina), Brazil (Ferreira, Soares, Souza) and China (Tian), all are areas of high, but largely undescribed, subterranean species richness. Phylogeography, a strong

theme in the past several conferences, continues to be a prominent research topic, with an entire session devoted to it. Both the number of genes sequenced and the breadth of the taxa analyzed continues to grow. This was especially noteworthy in Trontelj's presentation on the evolutionary history of the very large amphipod genus *Niphargus*. Also noteworthy is the diminished role of the Pleistocene as an agent forcing animals into caves and isolating them there. This is a big change in thinking that has occurred over the past several decades. According to by Delić, climate changes in the Pleistocene act more as selective agents, promoting thermal adaptation. But, we have probably not heard the last of the Pleistocene.

One of the newer approaches to research on evolution of cave animals is that of evolutionary developmental biologists, who analyze particular pathways of development of troglomorphic features, such as eye and pigment loss, and identify individual genes responsible for the changes. A theme of these talks was that there is often a trade-off between a reduced feature, such as eyes, and elaborated features, such as tastebuds (Jeffery, Ma). While the debate between the relative roles of selection and genetic drift continues, there are more and more examples of selection, even in unlikely systems such a melanin loss. Bilandžija showed that blockage of melanin production can lead to adaptive behavior changes resulting from increased levels of catecholamine. Many of the talks about the Mexican cavefish *Astyanax mexicanus* highlighted its potential use as a biomedical model. At a least a superficial sense, we learned that the Mexican cavefish is eyeless (Gross), has a deformed skull (O'Quinn) without pigment (Ma), fat (Rohner), and neurotic (Yoshizawa), and for these reasons may be a good model of some human diseases. It was this possibility that was the subject of Pennisi's *Science* article.

Just as our understanding of the evolutionary play in the subterranean world has grown by leaps and bounds, so has our understanding of the ecological theater. The scope of the theater itself was subject of a number of talks, including the presence of troglobionts and stygobionts in wetlands (Gottstein), sinkholes (Lewis), wells (Hahn, Siemensmeyer), calcrete (Cooper, Harms, Humphreys), scree slopes (Rendoš), canga (Soares), and deep caves (Borko). As usual, efficient sampling of the subterranean fauna remains elusive, but the technique of environmental DNA analysis has proved very useful in locating new sites of the black *Proteus* (Gorički) as well as fish and crayfish (Gabriel).

The mapping of subterranean biodiversity continues to be a hot topic, with several presenters (Ferreira, Reboleira) identifying caves with ten or more troglobionts and/stygobionts, the number ten being used by Culver and Sket (2000) to identify cave biodiversity hotspots. Several presenters (Lukić, Malard, Niemiller) discussed geographic patterns based on literally thousands of georeferenced data points, and this scale of analysis promises to be the wave of the future. While the forefront on analysis of the evolutionary play relies heavily on advances in molecular genetics and development, advances in understanding subterranean biodiversity rely on advances in data manipulation and statistical analysis.

There is perhaps no more fundamental question about the ecological theater of subterranean organisms than what subterranean organisms eat. Several talks (Hutchins, Engel) pointed to the growing recognition of the importance of chemoautotrophy.

The subterranean ecological theater is, by definition, dark. Yet, many, but not all, cave organisms avoid light; a few are indifferent to it. The response to light among different groups is perplexing but interesting, and not just due to differences in time since isolation in the dark. A surprising number of talks focused on this topic (Fišer, Fong, Worsham).

Conservation of the subterranean fauna was an overarching theme as well. Not only were there several sessions devoted explicitly to conservation, including an update on White-nose Syndrome, which affects many North American cave dwelling bats (Watson), many speakers in other sessions pointed to the vulnerability and rarity of the subterranean cave fauna. The most eloquent plea for speleobiologists to redouble their efforts at protection was that of Dante Fenolio, when he introduced his new book, *Life in the Dark*.

One of G. Evelyn Hutchinson's favorite sayings was that everything was relevant to an ecologist except perhaps the irregular Greek verbs. The meeting seemed to cover almost everything except the irregular Greek verbs, and one person's summary only weakly conveys the richness and diversity of the presentations. A list of oral presentations given at the meeting follows and abstracts of these and the posters can be found at www.speleobiology.com/icsb2016/conference-info/program/2016-icsb-abstracts/

A number of participants remarked positively about the large number of students and post-doctoral fellows in attendance. This was made possible by the generosity of several donors, which, on behalf of the Steering Committee, I wish to acknowledge:

- Den and Sheila Roenfeldt family
- Cave Conservancy of the Virginias
- Cave Conservancy Foundation
- Crustacean Society
- International Society of Subterranean Biology.

References

- Culver DC, Sket B (2000) Hotspots of subterranean biodiversity in caves and wells. *Journal of Cave and Karst Studies* 62: 11–17.
- Pennisi E (2016) Blind cave fish may provide insights into human health. *Science* 352: 1502–1503. doi: 10.1126/science.352.6293.1502

Oral presentations

Microbial indicators of air and water quality in a tropical cave.

Abris, Mattheus Imcon¹; Palanca, Mishael Grace¹; De Leon, Marian P.²;
Banaay, Charina Gracia B.*^{1,3}

¹ Environmental Biology Division, Institute of Biological Sciences, College of Arts and Sciences, University of the Philippines Los Baños, Laguna, Philippines

² Museum of Natural History, University of the Philippines Los Baños, Laguna, Philippines

³ Faculty of Management and Development Studies, University of the Philippines Open University, Los Baños, Laguna, Philippines

***Astyanax mexicanus* as a natural model for metabolic adaptation.**

Aspiras, Ariel¹; Tabin, Cliff¹; Rohner, Nicolas*²

¹ Department of Genetics, Harvard Medical School, Boston, Massachusetts, United States

² Stowers Institute for Medical Research, Kansas City, Missouri, United States

Character systems and criteria for species diagnosis in *Plutomurus* (Collembola, Tomoceridae), with description of two new species from Georgian caves (Caucasus).

Barjadze, Shalva*¹; Baquero, Enrique²; Soto-Adames, Felipe³; Giordano, Rosanna³; Jordana, Rafael²

¹ Institute of Zoology, Ilia State University, Tbilisi, Republic of Georgia

² Department of Environmental Biology, University of Navarra, Pamplona, Navarra, Spain

³ Department of Entomology, University of Illinois at Urbana-Champaign, Champaign, Illinois, United States

Brazilian subterranean amphipods with notes on their ecology and conservation.

Bastos-Pereira, Rafaela*; Ferreira, Rodrigo Lopes

Study Center on Subterranean Biology, Biology Department, Federal University of Lavras. Lavras, Minas Gerais, Brazil

Microbiological monitoring in Romanian show caves.

Bercea, Silviu¹; Nastase-Bucur, Ruxandra¹; Kenesz, Marius¹;

Constantin, Silviu²; Moldovan, Oana Teodora*¹

¹ Department of Cluj, Emil Racovitza Institute of Speleology, Cluj-Napoca, Romania

² Department of Geospeology and Palentology, Emil Racovitza Institute of Speleology, Bucuresti, Romania

Evolution of melanin pigment regression in cave animals.

Bilandžija, Helena

Department of Biology, University of Maryland, College Park, Maryland,
United States; Department of Molecular Biology, Ruđer Bošković Institute, Zagreb,
Croatia; Croatian Biospeleological Society, Zagreb, Croatia

Deep cave fauna – fact or fiction?

Borko, Špela*; Delić, Teo; Trontelj, Peter

Department of Biology, Biotechnical Faculty, University of Ljubljana, Ljubljana,
Slovenia

Geographically structured genetic diversity in the cave beetle *Darlingtonia kentuckensis* Valentine 1952 (Coleoptera: Carabidae: Trechinae).

Boyd, Olivia F.*¹; Johnson, Jarrett²; Philips, T. Keith²

¹Department of Integrative Biology, Oregon State University, Corvallis, Oregon,
United States

²Department of Biology, Western Kentucky University, Bowling Green, Kentucky,
United States

Speleotranscriptome profiling casts light on differential expression and polymorphism in cave and surface populations of the amphipod *Gammarus minus*.

Carlini, David B.

Department of Biology, American University, Washington, District of Columbia,
United States

A working relationship between the Missouri Department of Conservation and caving organizations.

Colatskie, Shelly*; Elliott, Anthony

Missouri Department of Conservation, Powder Valley Conservation Nature
Center, 11715 Cragwold Road, Kirkwood, Missouri 63122, United States

Regressive evolution of beetles from the subterranean archipelago of Western Australia: insights from comparative transcriptomics.

Cooper, Steven John Baynard*^{1,2}; Tierney, Simon Martin¹; Hyde, Josephine Charlotte Anne¹; Saint, Kathleen Margaret²; Bertozzi, Terry^{1,2}; Austin, Andrew Donald¹;
Humphreys, William Frank³

¹Australian Centre for Evolutionary Biology and Biodiversity, and School of Biological Sciences, The University of Adelaide, Adelaide, South Australia, Australia

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Adelaide, South Australia, Australia

³Terrestrial Zoology, Western Australian Museum, Welshpool, Western Australia,
Australia

**Predicting the occurrence of cave-inhabiting fauna based on features of the
surface environment.**

Culver, David C.¹; Christman, Mary C.²; Doctor, Daniel H.³; Niemiller, Matthew
L.^{*4}; Weary, David J.³; Young, John A.⁵; Zigler, Kirk S.⁶

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of Columbia, United States

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Gainesville, Florida, and MCC Statistical Consulting LLC, Gainesville, Florida,
United States

³U.S. Geological Survey, Reston, Virginia, United States

⁴Illinois Natural History Survey, Prairie Research Institute, University of Illinois
Urbana-Champaign, Champaign, Illinois, United States

⁵U.S. Geological Survey, Leetown Science Center, Kearneysville, West Virginia,
United States

⁶Department of Biology, The University of the South, Sewanee, Tennessee,
United States

**Phylogeography, haplotype diversity and niche differentiation among fresh-
water crab *Sundathelphusa* species (Decapoda: Brachyura: Gecarcinucidae) in
the subterranean habitat of Quezon, Philippines.**

Cunanan, Dianne Jaula^{*}; Husana, Daniel Edison

Environmental Biology Division, Institute of Biological Sciences, College of Arts
and Sciences, University of the Philippines Los Baños, College, Laguna, Philippines

**Thermal adaptation, a new driver of ecological speciation in subterranean
fauna.**

Delić, Teo^{*}; Trontelj, Peter; Fišer, Cene

Subterranean Biology Lab, Department of Biology, University of Ljubljana,
Ljubljana, Slovenia

Distribution and diversity of stygobionts in Poland.

Dumnicka, Elzbieta^{*}; Galas, Joanna

Institute of Nature Conservation, Polish Academy of Sciences, al. A. Mickiewicza
33, 31-120 Krakow, Poland

Traits of terrestrial subterranean biota of the Western Carpathians (Central Europe) are affected by productivity of above ground ecosystems.

Elhottová, Dana¹; Kováč, Ľubomír*²; Nováková, Alena³; Chroňáková, Alica¹; Mock, Andrej²; Krištúfek, Václav¹; Mulec, Janez⁴; Lukešová, Alena¹; Ľuptáčík, Peter²; Parimuchová, Andrea²; Papáč, Vladimír⁵; Miklisová, Dana⁶; Fenda, Peter⁷; Jászay, Tomáš⁸; Košel, Vladimír⁹

¹Biology Centre ASCR, v. v. i., Institute of Soil Biology, České Budějovice, Czech Republic

²Department of Zoology, Institute of Biology and Ecology, Faculty of Science, P. J. Šafárik University, Košice, Slovakia

³Institute of Microbiology of the CAS, v. v. i., Prague, Czech Republic

⁴Karst Research Institute ZRC SAZU, Postojna, Slovenia

⁵State Nature Conservancy SR, Slovak Caves Administration, Rimavská Sobota, Slovakia

⁶Institute of Parasitology SAS, Košice, Slovakia

⁷Department of Zoology, Faculty of Natural Sciences, Comenius University, Bratislava, Slovakia

⁸Šarišské múzeum, Bardejov, Slovakia

⁹Hornádska 24, 821 07 Bratislava, Slovakia

A macroecological take on European groundwater biodiversity patterns.

Eme, David^{1,2}; Zagmajster, Maja³; Delić, Teo³; Douady, Christophe¹; Fišer, Cene³; Flot, Jean-François⁴; Galassi, Diana M.P.⁵; Konecny-Dupré, Lara¹; Marmोनier, Pierre¹; Stoch, Fabio⁵; Zakšek, Valerija³; Malard, Florian*¹

¹UMR 5023 LEHNA, University of Lyon 1, CNRS, ENTPE, Villeurbanne, France

²Department of Life and Environmental Sciences, University of Iceland, Reykjavik, Iceland

³Department of Biology, Biotechnical Faculty, University of Ljubljana, Ljubljana, Slovenia

⁴Evolutionary Biology & Ecology, Université Libre de Bruxelles, Brussels, Belgium

⁵Department of Life, Health & Environmental Sciences, University of L'Aquila, L'Aquila, Italy

Prevalence of microbial taxonomic groups to specific subterranean habitats may shed light on ubiquity of microbial function in cave ecosystems.

Engel, Annette Summers

Earth and Planetary Sciences, University of Tennessee, Knoxville, Tennessee, USA

Threats to the conservation of stygobionts.

Fenolio, Danté

Conservation & Research, San Antonio Zoo, San Antonio, Texas, United States

Iron ore plateaus in the Amazon forest: hotspots of subterranean biodiversity?

Ferreira, Rodrigo Lopes

Study Center on Subterranean Biology, Biology Department, Federal University of Lavras. Lavras, Minas Gerais, Brazil

Brazilian troglomorphic fauna: besides raising the knowledge, are we contributing to their conservation?

Ferreira, Rodrigo Lopes*; Souza-Silva, Marconi

Study Center on Subterranean Biology, Biology Department, Federal University of Lavras. Lavras, Minas Gerais, Brazil.

Brazilian vs. Slovenian aquatic subterranean biodiversity: the case of Areias and Postojna-Planina cave systemsFerreira, Rodrigo Lopes¹; Souza-Silva, Marconi^{1*}; Fišer, Cene²; Zagmajster, Maja²; Prevorčnik, Simona²; Sket, Boris²¹Center of studies on Subterranean Biology, General Zoology sector, Department of Biology, Federal University of Lavras, Minas Gerais, Brazil²Department of Biology, Biotechnical Faculty, University of Ljubljana, Jamnikarjeva 101, 1000 Ljubljana, Slovenia.**Searching for reproductive barriers between sympatric surface and subterranean ecomorphs of *Asellus aquaticus*.**

Fišer, Žiga*; Trontelj, Peter

Department of Biology, Biotechnical Faculty, University of Ljubljana, Ljubljana, Slovenia

Variation in phototactic behavior among surface and subterranean gammarid and crangonyctid amphipod species from different habitats.Fong, Daniel Wu¹; Wanner, Maria J.²¹Department of Biology, American University, Washington, District of Columbia, United States²Department of Biology, Gettysburg College, Gettysburg, Pennsylvania, United States

Adult lens cuticle deposition in a microphthalmic cave beetle.

Friedrich, Markus^{*1,2}; Kulacic, Jasmina¹

¹Department of Biological Sciences, Wayne State University, Detroit, Michigan, United States

²Department of Cellular Biology and Anatomy, Wayne State University, Detroit, Michigan, United States

Cave animals at the dawn of speleogenomics.

Friedrich, Markus

Department of Biological Sciences and Department of Cellular Biology and Anatomy, Wayne State University, Detroit, Michigan, United States

Environmental DNA for monitoring and detection of rare and endangered cavefish and cave crayfish in the Ozark Highlands.

Gabriel, Ana E.^{*1}; Van Den Bussche, Ronald A.¹; Brewer, Shannon K.²; Stark, Richard³; Niemiller, Matthew L.⁴; Fenolio, Dante B.⁵

¹Oklahoma State University, Stillwater, Oklahoma, USA

²U.S. Geological Survey, Oklahoma Cooperative Fish and Wildlife Research Unit

³U.S. Fish and Wildlife Service

⁴Illinois Natural History Survey, Prairie Research Institute, University of Illinois Urbana-Champaign

⁵San Antonio Zoo

Long term population trends of biota in White Cave, Mammoth Cave National Park (2003-2016).

Gilmore, Terrence¹; Lavoie, Kathleen^{*1}; Helf, Kurt²; Poulson, Thomas³

¹Biological Sciences, State University of New York College at Plattsburgh, Plattsburgh, New York 12901

²Cumberland-Piedmont Network, National Park Service, Mammoth Cave, Kentucky 42259

³318 Marlberry Circle, Jupiter, Florida, United States

Searching for black *Proteus* (*Proteus anguinus parkelj*) in karst groundwater with the help of eDNA.

Gorički, Špela^{*1}; Stanković, David^{1,2}; Năpăruș-Aljančić, Magdalena¹; Snoj, Aleš³; Aljančić, Gregor¹

¹Tular Cave Laboratory, Society for Cave Biology, Kranj, Slovenia

²Department of Life Sciences, University of Trieste, Trieste, Italy

³Department of Animal Science, Biotechnical faculty, University of Ljubljana, Ljubljana, Slovenia

Microhabitat selection of subterranean amphipods in the Western Balkan peat bog.

Gottstein, Sanja^{*1}; Brigić, Andreja¹; Kerovec, Mladen¹; Ternjej, Ivančica¹

¹Department of Biology, Faculty of Science, University of Zagreb, HR-10000 Zagreb, Croatia

Genetic analysis of craniofacial changes in blind Mexican Cavefish, *Astyanax mexicanus*.

Gross, Joshua

Department of Biological Sciences, University of Cincinnati, 312 Clifton Court, Rieveschl Hall Room 711B, Cincinnati, Ohio 45221-0006, United States

Challenges and rewards of subterranean fauna environmental impact assessment.

Halse, Stuart

Bennelongia Environmental Consultants, 5 Bishop Street, Jolimont, Western Australia 6014, Australia

Biodiversity in complex subterranean systems: a tale of arachnids in arid Western Australia.

Harms, Danilo^{*}; Halse, Stuart; McRae, Jane; Scanlon, Michael; Curran, Michael
Bennelongia Environmental Consultants, 5 Bishop Street, Jolimont WA 6014, Australia.

Shape variation within the Southern Cavefish, *Typhlichthys subterraneus* (Percopsiformes: Amblyopsidae).

Hart, Pamela^{*}; Burress, Edward; Armbruster, Jonathan.

Department of Biological Sciences, Auburn University, Auburn, Alabama, United States

Patterns on patterns: The rise and rise of Australian subterranean biodiversity.

Humphreys, William F.

Department of Terrestrial Zoology, Western Australian Museum, Locked Bag 49, Welshpool DC, Western Australia 6986, Australia; School of Animal Biology, University of Western Australia, Crawley, Western Australia 6009, Australia.

Conservation of subterranean species and habitats in Australia.

Humphreys, William F.^{*1,2}; Humphreys, Garth^{2,3}

¹Department of Terrestrial Zoology, Western Australian Museum, Locked Bag 49, Welshpool DC, Western Australia 6986, Australia; School of Earth and Environmental Sciences, University of Adelaide, South Australia 5005, Australia.

²School of Animal Biology, University of Western Australia, Crawley, Western Australia 6009, Australia.

³Biota Environmental Sciences Pty Ltd, PO Box 155, Leederville, Western Australia 6903, Australia.

Phylogeography of crab genus *Sundathelphusa*: history of extensive migration, cave colonization and refugia in the Philippines.

Husana, Daniel Edison^{*1}; Haga, Takuma²; Kase, Tomoki³

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²Toyohashi Museum of Natural History, 1-238 Oana, Oiwa-cho, Toyohashi, Aichi 441-3147, Japan

³Invertebrate Paleontology Division, National Museum of Nature and Science, 4-1-1 Amakubo, Tsukuba City, Ibaraki 305-0005 Japan

Biodiversity, stability, and trophic complexity in the Edwards Aquifer, United States:

The influence of chemolithoautotrophy on stygobiont community structure.

Hutchins, Benjamin T.^{*1,2}; Engel, Annette Summers³; Nowlin, Weston H.²; Schwartz, Benjamin F.^{3,4}

¹Texas Parks and Wildlife Department, Austin Texas, United States

²Texas State University, Aquatic Station, Department of Biology, San Marcos, Texas, United States

³University of Tennessee, Department of Earth and Planetary Sciences, Knoxville, Tennessee, United States

⁴Edwards Aquifer Research and Data Center, Texas State University, San Marcos, Texas, United States

Conservation status of stygobionts in Texas, United States.

Hutchins, Benjamin T.

Texas Parks and Wildlife Department, Austin, Texas, United States

Homocystinuria in Cavefish: Molecular analysis of an *Astyanax* eye QTL reveals the role of cystathionine β -synthase in eye degeneration.

Jeffery, William

Department of Biology, University of Maryland, College Park, Maryland,
United States

Investigating the physico-chemical niche of obligate subterranean amphipods in shallow subterranean waters of the DC metro area.

Keany, Jenna^{*1}; Culver, David¹; Knee, Karen¹; Fong, Daniel²

¹Department of Environmental Science, American University, Washington, District of Columbia, United States

²Department of Biology, American University, Washington, District of Columbia, United States

As above, so below? Testing for gene flow between cave and surface-dwelling populations of *Garra barreimiae*.

Kirchner, Sandra^{*1,2}; Sattmann, Helmut³; Plan, Lukas⁴; Krenn, Harald¹; Victor, Reginald⁵; Haring, Elisabeth^{1,2}; Kruckenhauser, Luise²

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⁴Department for Geology & Paleontology, Natural History Museum, Burgring 7, 1010 Vienna, Austria

⁵Department of Biology, Sultan Qaboos University, Al Khoudh, Muscat 123, Oman

Synchronous ceiling-floor pitfall trapping allows study of microdistribution and habitat preferences of terrestrial subterranean fauna in caves.

Kozel, Peter^{*1,3}; Pipan, Tanja¹; Culver, David²; Šajna, Nina³; Polak, Slavko⁴; Novak, Tone³

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²Department of Environmental Science, American University, Washington, District of Columbia, United States

³ Department of Biology, Faculty of Natural Sciences and Mathematics, University of Maribor, Slovenia

⁴ Zavod Znanje, OE Notranjska Museum Postojna, Slovenia

Long-term cave adaptation and diversification in the *Ptomaphagus hirtus*-group (Coleoptera: Leiodidae: Cholevinae).

Leray, Vincent L.¹; Zigler, Kirk S.*²; Friedrich, Markus³

¹American University, Washington, District of Columbia, United States

²University of the South, Sewanee, Tennessee, United States

³Wayne State University, Detroit, Michigan, United States

Improving outcomes and modifying policies with evidence-based research on the karst of the Hoosier National Forest.

Lewis, Julian J.*; Lewis, Salisa L.

Lewis and Associates LLC, 17903 State Road 60, Borden, Indiana, United States

Disjunct distribution of terrestrial troglobiotic species in Europe: the case of Collembola.

Lukić, Marko*^{1,2,3}; Delić, Teo³; Zagmajster, Maja³; Bedos, Anne⁴; Deharveng, Louis⁴

¹Ruđer Bošković Institute, Zagreb, Croatia

²Croatian Biospeleological Society, Zagreb, Croatia

³Department of Biology, Biotechnical Faculty, University of Ljubljana, Ljubljana, Slovenia

⁴Muséum National d'Histoire Naturelle, UMR7205 CNRS/MNHN, Paris, France

Molecular analysis of melanophore lineage genes in cavefish depigmentation.

Ma, Li*¹; Stahl, Bethany^{1,2}; Adams, Hannah¹; Gross, Joshua¹

¹Department of Biological Sciences, University of Cincinnati, Cincinnati, Ohio, United States

²Department of Biological Sciences, Florida Atlantic University, Jupiter, Florida, United States

Home range and habitat use of foraging *Myotis grisescens* from five maternity sites in northern Arkansas using aerial tracking.

Moore, Patrick Ryan*; Morris, Keith; Rolland, Virginie; Risch, Thomas Stephen

Department of Biological Sciences, Arkansas State University, Jonesboro, Arkansas 72467, United States

Estimating the trophic ecology of aquatic invertebrate using stable isotopes.

Nair, Parvathi*¹; Nowlin, Weston¹; Diaz, Pete²

¹Department of Biology, Texas State University, San Marcos, Texas, United States

²US Fish and Wildlife Service, San Marcos, Texas, United States

Conservation of amblyopsid cavefishes (Percopsiformes: Amblyopsidae) of the Ozark Highlands and Interior Low Plateau karst regions, USA.

Niemiller, Matthew L.

Illinois Natural History Survey, Prairie Research Institute, University of Illinois
Urbana-Champaign, Champaign, Illinois, United States

Ecological and consumer-driven nutrient recycling in a subterranean aquatic community.

Nowlin, Weston H.*¹; Loney, Lauren¹; Hutchins, Benjamin²; Schwartz, Benjamin F.³

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Texas, United States

²Texas Parks and Wildlife Department, Austin, Texas, United States

³Edwards Aquifer Research and Data Center/Department of Biology, Texas State
University, San Marcos, Texas, United States

Are cave sampling methods effective to assess subterranean fauna richness?

Oliveira, Marcus Paulo Alves*; Ferreira, Rodrigo Lopes

Department of Biology, Universidade Federal de Lavras, Lavras, Minas Gerais,
Brazil

**The evolution of scleral ossification in the Mexican Cavefish
(*Astyanax mexicanus*).**

O'Quin, Kelly E.*¹; Doshi, Pooja²; Lyon, Anastasia¹; Hoenemeyer, Emma¹;
Yoshizawa, Masato³; Jeffery, William R.²

¹Biology Program, Centre College, Danville, Kentucky, United States

²Department of Biology, University of Maryland, College Park, Maryland,
United States

³Department of Biology, University of Hawaii at Manoa, Honolulu, Hawaii,
United States

Conserving cave invertebrate fauna in Virginia (USA).

Orndorff, William David

Virginia Department of Conservation and Recreation, Natural Heritage Program,
Richmond, Virginia, United States

Niche bacterial and archaeal community compositions as indicators of ecosystem processes and health in Bahamian and Mexican anchialine caves.

Paterson, Audrey T.^{*1}; Iliffe, Thomas M.²; Bracken-Grissom, Heather³; Pérez-Moreno, Jorge L.³; Porter, Megan⁴; Gonzalez, Brett C.⁴; Engel, Annette Summers¹

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²Department of Marine Biology, Texas A&M University at Galveston, Galveston, Texas, United States

³Department of Biological Sciences, Florida International University-Biscayne Bay, North Miami, Florida, United States

⁴Marine Biology Section, University of Copenhagen, Copenhagen, Denmark

Remarkable biodiversity of a neglected group of stygofauna: Bathynellidae (Bathynellacea, Crustacea) in the north of Western Australia.

Perina, Giulia^{*1,2}; Huey, Joel²; Camacho, Ana³; Horwitz, Pierre¹; Koenders, Annette¹

¹Centre for Ecosystem Management, Edith Cowan University, Joondalup, Western Australia, Australia

²Western Australian Museum, Welshpool, Western Australia, Australia

³Museo Nacional de Ciencias Naturales (CSIC), Dpto. Biodiversidad y Biología Evolutiva, Madrid, Spain

Uncovering divergent lineages and phylogeographic structure in an obligate cave-dwelling Salamander (*Eurycea spelaea*).

Phillips, John G.^{*1}; Fenolio, Dante B.²; Emel, Sarah L.^{1,3}; Bonnett, Ronald M.¹

¹Department of Biological Sciences, University of Tulsa, 800 South Tucker Drive, Tulsa, Oklahoma, United States

²San Antonio Zoo, San Antonio, Texas, United States

³Department of Biology, Temple University, Philadelphia, Pennsylvania, United States

Phylogeny and systematic of the enigmatic Anthroherponina (Leptodirini, Cholevinae, Leioididae, Coleoptera).

Polak, Slavko^{*1}; Delić, Teo²; Trontelj, Peter²

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Cuticular hydrocarbon analysis of cave versus surface Hawaiian planthoppers.Porter, Megan Linnay^{*1}; Yew, Joanne ²¹Department of Biology, University of Hawai'i at Mānoa, Honolulu, Hawaii,
United States²Pacific Bioscience Research Center, University of Hawai'i at Mānoa, Honolulu,
Hawaii, United States**Food limitation is necessary to explain elaborated troglomorphy in some species.**

Poulson, Thomas L.

318 Marlberry Circle, Jupiter, Florida, United States

The evolution of craniofacial shape change in the blind Mexican Cavefish.Powers, Amanda^{*}; Davis, Erin; Kaplan, Shane; Gross, JoshuaDepartment of Biological Sciences, University of Cincinnati, Cincinnati, Ohio,
United States**Developmental and genetic analysis of eye and pigment loss in the cave isopod *Asellus aquaticus*.**Mojaddidi, Hafasa¹; Klein, Emily²; Trontelj, Peter³; Protas, Meredith^{1*}¹Department of Natural Sciences and Mathematics, Dominican University of
California, San Rafael, California, United States²Department of Biology, Whitman College, Walla Walla, Washington,
United States³Department of Biology, Biotechnical Faculty, University of Ljubljana, Ljubljana,
Slovenia**Portugal - the emergence of a new hotspot of subterranean biodiversity in Europe.**

Reboleira, Ana Sofia P. S.

Natural History Museum of Denmark (Zoological Museum), University of Copenhagen, Universitetsparken 15, DK-2100 København Ø, Denmark.

“Troglobiário” – a cave lab building bridges between citizens and science.Reboleira, Ana Sofia P. S.^{*1,2}; Fernandes, Maria Jesus³; Martins, Olímpio³¹Natural History Museum of Denmark, University of Copenhagen, Universitetsparken 15, DK-2100 Copenhagen, Denmark

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Unsafe sex – interesting interactions between cave inhabitants.

Reboleira, Ana Sofia P. S.*; Enghoff, Henrik

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Organic carbon content as substantial factor affecting diversity and vertical distribution of Collembola on forested scree slopes.

Rendoš, Michal *¹; Raschmanová, Natália ¹; Miklisová, Dana ²; Mock, Andrej¹; Ľuptáček, Peter¹; Kováč, Ľubomír¹

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Physiochemical differences in water sources within De Leon Springs, Florida, and their potential effect on cave biota.

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Molecular and morphological analysis of *Stygobromus* sp. near San Marcos, Texas.

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The effects of well type and quality on sampling of stygofaunal communities.Siemensmeyer, Tobias^{*1,2}; Schwenk, Klaus²; Hahn, Hans Jürgen¹¹Institute for Groundwater Ecology IGE GmbH, University of Koblenz Landau,
Fortstr. 7, 76829 Landau, Rheinland-Pfalz, Germany²Institute for Environmental Sciences, University of Koblenz Landau, Fortstr. 7,
76829 Landau, Rheinland-Pfalz, Germany**Building a constituency for karst conservation.**Simon, Scott^{*}; Slay, Michael E.Arkansas Field Office, The Nature Conservancy, 601 North University Avenue,
Little Rock, Arkansas, United States**Troglomorphic fauna sampling methods in canga formations, Minas Gerais State, Brazil.**Soares, Gustavo^{*}; Andrade, Renata; Perroni, Gustavo
Instituto do Carste, Belo Horizonte, Minas Gerais, Brazil**Updated records of troglomorphic palpigrades in Brazil.**Souza, Maysa Fernanda Villela Rezende^{*}; Ferreira, Rodrigo Lopes
Study Center on Subterranean Biology, Biology Department, Federal University
of Lavras, Lavras, Minas Gerais, Brazil**Global warming – where are the refugia for cold-stenothermous stygofauna?**Spengler, Cornelia; Hahn, Hans Jürgen^{*}University of Koblenz Landau, Institute for Environmental Sciences, Fortstr. 7,
76829 Landau, Rheinland-Pfalz, Germany**Species delimitation and phylogeography of *Hesperochnes* (Pseudoscorpiones: Chernetidae) from karst regions of the southeastern United States.**Stephen, Charles Donald Robert^{*1}; Niemiller, Matthew Lance²; Bond, Jason Edward¹¹Department of Biological Sciences, Auburn University, Auburn, Alabama,
United States²Illinois Natural History Survey, Prairie Research Institute, University of Illinois
Urbana-Champaign, Champaign, Illinois, United States

Documenting Missouri cave biology – from Ruth Hoppin to Missouri Cave Database.

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Integrative taxonomy of cryptic subterranean Amphipods (Niphargidae: *Niphargus*) from Dinaric Karst.

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Cave-dwelling terrestrial isopods (Crustacea, Oniscidea) from Southeast Asia: a review.

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Current status and habitat use of the Foushee cavesnail, *Amnicola cora* (Hydrobiidae) in Foushee Cave, Independence County, Arkansas.

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Diversity and distribution of cavernicolous ground beetles (Insecta: Coleoptera: Carabidae) in China.

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Crossing to the dark side: the South Central Texas *Eurycea* clade as a novel subterranean model system for the study of evolutionary developmental biology.

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The origin of niphargids revisited and tested at the continental scale.

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StygoTracing - a biological tracing method for underground waters.

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Geomicrobiology study in Heshang Cave, central China.

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Managing the spread of *Pseudogymnoascus destructans* and conserving bats threatened by White-nose Syndrome in North America.

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How the Endangered Species Act protects subterranean fauna in central Texas.

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The effect of selection on the phenotype of response to light in subterranean, epigeal, and interstitial Crangonyctidae.

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Adaptation through changes of behavioral and morphological traits in Mexican Cavefish.

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Yoshida, Mina¹; Keene, Alex²

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The neglected subterranean biodiversity hotspot under threat: can we protect the aquatic interstitial fauna of the Sava River in the Balkans (Europe)?

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